

## **Chapter 15**

### **Systems Audit Criteria & Procedures for Evaluating Ambient Air Monitoring Networks**



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## **1.0 Introduction**

This chapter will serve as a guideline for ambient air monitoring network evaluations performed by the Indiana Department of Environmental Management (IDEM), Office of Air Quality (OAQ), Quality Assurance Section (QAS). These evaluations will be performed on all organizations (state, local, and industrial/consultant) that report data to the Air Quality System (AQS) database for the State of Indiana. The data is used for statistical analysis and to determine compliance with federal and state air pollution regulations. These evaluations assist the state in determining the accuracy and reliability of the data being collected and the quality of the air monitoring programs in general. The evaluations are performed in accordance with 40 CFR Parts 50 and 58. Topics to be covered in this chapter include:

- 1.1 Quality Assurance Plan Review and Approval (see Section 2.0)
- 1.2 Evaluation Procedures (see Section 3.0)
- 1.3 Systems Audit (see Section 4.0)

The criteria and guidelines used for the evaluations will depend partly on the reason for the monitoring, e.g. Prevention of Significant Deterioration (PSD), SO<sub>2</sub> Rule, Agreed Order, Special Purpose Monitoring, or the State Implementation Plan (SIP).

This chapter covers specific information on the evaluation process. For detailed information on monitoring of specific parameters, refer to the appropriate chapters of this manual.

## **2.0 Quality Assurance Plan Review and Approval**

A Quality Assurance Plan should be submitted to the QA Section for review and approval prior to the initial start date for any monitoring program. The plan is required to explain specific information for the proposed site(s) such as the reason for monitoring, who will be doing the monitoring, duration of the monitoring, and where the monitoring will take place. In addition, the plan must contain detailed procedures on calibrations, audits, data collecting, and all quality assurance activities.

The plan should be reviewed by the QAS prior to the start date of monitoring. After the plan has been reviewed, an approval/recommendation letter is written by the QAS with comments stating requirements and recommendations. Requirements are procedures which must be met. Recommendations are made to ensure procedures are consistent throughout the state. The comments are then sent back to the reporting organization and any involved parties pending required changes in operation or documentation. Reviewing the QA Plan prior to the start date is an effective way to catch procedural errors early. Revisions and updates to the plan must also be reviewed as changes to the networks occur.

## **3.0 Evaluation Procedures**

The evaluation process begins by contacting the site operators approximately 30 days prior to the evaluation. Once a date for a site visit is agreed on, the QAS refers to a site book to ensure the information is up-to-date. A site book contains pictures, maps, a site evaluation form (Form 1),

and specific information on the air networks that are kept by the QAS. If all sites in a network cannot be visited, the sites with the most problems during the last evaluation and the sites which have not been evaluated the previous year will have priority. The evaluation process generally involves reviewing all documentation, reviewing certification information, checking siting, performing audits, and evaluating operator technique. This process is followed with a detailed correspondence describing requirement deficiencies with recommendations which will improve the monitoring network.

### **3.1 Documentation**

The documentation by the reporting organization is checked to ensure that all work performed is consistent with the Code of Federal Regulations, Quality Assurance Handbook for Air Pollution Measurement Systems, and the IDEM, OAQ, QA manual. The site logbook, quarterly reports, and other pertinent paperwork are reviewed to verify documentation is organized and useful. The following areas are examined by the QAS to verify that adequate documentation is kept:

- biweekly precision and quarterly accuracy audits
- quarterly report and Precision and Accuracy Report (PARS)
- certifications and calibrations

The documentation of the areas above are checked to ensure that calculations are performed correctly, audit concentrations are run in the correct ranges, certifications, audits, and calibrations are performed on time. Documentation is also checked to answer the following questions:

- Were flows taken if the audit device was a permeation system?
- Was the indoor temperature sensor certified by the site operator, if so was the certification documented?
- Were the accuracy audits performed with a different piece of equipment than what was used to calibrate the analyzer?
- Were there periods of invalid data and was the reason of the invalid data documented?

In addition, PARS is checked prior to the evaluation to ensure timely submittal, audits show consistent results, and audits are run in the correct ranges.

Furthermore, if particulate monitoring is being performed, a well organized logbook must be kept to ensure proper quality assurance procedures are followed. If the company or agency performs filter weighing, the QAS will check the following items:

- quality assurance checks of initial and final weights to ensure they are being performed and meet the limits for weight and minimum number of filters checked
- the equipment used in the filter preparation area has been certified (e.g. thermometers, relative humidity sensors, ANSI Class weights) and copies of certifications performed by the company or agency are being sent to the QAS

- the balance checks are performed in the correct ranges
- elapsed time meters (were they certified?, were the audits performed?)
- the filter cards are checked for chain of custody, pre and post sampling flow meter drift checks, elapsed time 1440 minutes  $\pm$  60 minutes
- filter handling and weighing procedures meet requirements (see Chapter 7)

If the company or agency is located out of state, a filter handling questionnaire is sent to the laboratory weighing the filters (Form 3).

### **3.2 Certifications**

The reporting organization's certification information is reviewed to ensure that the transfer standards being used for calibrations and audits are being certified through the QA certification facility. Equipment certifications are checked prior to the site(s) being visited by the QAS. This ensures that all transfer standards throughout the state are referenced back to primary standards used by the State of Indiana for uniformity and accuracy. The certifications must meet the time frames and criteria established in Chapter 6 of the Quality Assurance Manual. If the agency or company performs their own certifications, then copies of these certifications must be sent to the QAS. All companies hired to perform calibrations or accuracy audits must also certify their transfer standards with the QA Section if the air monitoring data is to be submitted to the AQS for the State of Indiana. Accuracy audit and calibration records are also reviewed to ensure a designated, certified piece of equipment is used for each.

### **3.3 Siting**

Siting involves measuring distances and heights, taking directional pictures, and drawing a map of the surrounding area. Several items need to be considered when measuring distances to potential obstructions: the direction of the source, topography, parameter, the type of monitoring, and the type of obstruction (trees or building). The general rule to follow when measuring for obstructions is the 2 times rule. This rule states the distance to an obstruction must be at least twice the distance that the height of the obstruction extends above the inlet or probe. The siting is checked on every evaluation to ensure that changes have not occurred such as the growth of trees interfering with the sampling.

Pictures are also taken of instruments at the sites. Additional pictures will be taken if questionable siting exists.

A detailed map is made of each site showing distances, heights, directions, ground cover, and anything relevant to the collection of data.

A form is filled out which states specific site information on continuous and intermittent parameters (see Form 1). The meteorological parameters have check-off forms which ensure that the siting is adequate (see Chapter 9). In addition, when a site is visited for an evaluation a site inspection form is filled out (see Form 2). These forms are kept together with the pictures and map of the site in a site book kept by the QA Section.

## 4.0 Systems Audit

A systems audit consists of a "performance audit" and a "system audit". Performance audits are a quantitative determination of the accuracy of each measurement parameter relative to known standards. A system audit provides an independent qualitative assessment of the overall function of the network, how quality assurance is being implemented, and how well documentation of the network operator's actions is being kept. Each instrument used to collect data for AQS is audited by the QAS. These audits accomplish several goals: ensuring the equipment meets specifications, meeting site operators to discuss problems or questions relating to monitoring, and making recommendations to assist in efficient operation of the network.

A "performance audit" is conducted by introducing known standards into the equipment used to collect the data. These standards are for continuous, intermittent, and meteorological parameters. When auditing a continuous air monitoring analyzer, only a validation concentration (approximately 80% of analyzer range) is introduced into the analyzer. This determines if the analyzer is in calibration. Intermittent audits consist of one point flow comparison to a QA calibrated orifice. The meteorological audit procedures will vary with the parameter. The results of a performance audit can be compared to previous audits performed by the site operator.

When conducting a performance audit, information is gathered on the safety conditions and the cleanliness at the sites. The following items are checked for safety:

- Electrical connections should not be exposed to the weather.
- Extension cords should not be cracked or brittle.
- Ladders and railings should be secure.
- Cylinders should be secured with a chain or tie down strap.
- Access to the site should be safe in general.

The following items are checked for cleanliness:

- A particulate sampler should be free of dust and dirt in the filter collection area and overall.
- The manifold used in continuous sampling should be free of dust and dirt.
- The candy cane used in continuous sampling should be free of dust and dirt.
- The sample lines going from the manifold to the continuous analyzers should be free of dust, dirt, and condensation.
- The continuous analyzers should be free of dust, dirt, and clutter.
- The overall condition of the site should be free of extra equipment, bent or rusty fencing, broken skirting, etc.

Many items are checked by discussing with the site operators. The following items are examples of information gathered when conducting an intermittent particulate sampling network evaluation:

- Are the manometers leak checked prior to use?
- Was the thermometer placed out of direct sunlight?
- How was the barometric pressure taken? (If called into a weather station, was corrected or station pressure given?)
- Who performs the accuracy audits and calibrations?

In addition, the following items are checked when conducting a continuous analyzer network performance audit:

- Is there a 5% offset on the strip chart?
- Do the values of the strip chart match the data logger? (Has the strip chart been calibrated?)
- Does the daily span meet the drift limits for 24 hour periods?
- Is the sample train composed of nonreactive material? (e.g. Teflon, borosilicate glass)
- When the site operator audits, do they go through the sample inlet?
- If meteorological audits are being performed, is the equipment certified?

A "system audit" is performed by reviewing calibrations, audits, and other documentations to ensure timelines have been met and information is accurate. In addition, site operator procedures and documentation are compared to the procedures outlined in the Quality Assurance Plan. Other aspects of the system audit are to review the site logbook for information about analyzer drift, calibrations, specific problems with the instruments, and what actions were taken by the site operators. Furthermore, the site logbook should reveal if any data was invalidated and why. The filter logbook is checked to ensure quality assurance limits and procedures are consistent.

# Form 1

## Continuous and Intermittent Site Evaluation

Location: \_\_\_\_\_

Date: \_\_\_\_\_

AQS #: \_\_\_\_\_

Auditor: \_\_\_\_\_

### I. Scale of Representativeness

Parameter	Micro	Middle	Neighborhood	Urban	Regional	N/A
SO <sub>2</sub>						
CO						
O <sub>3</sub>						
NO <sub>2</sub>						
Pb						
PM <sub>10</sub>						
PM <sub>2.5</sub>						

Is this station category (a), maximum concentration, or category (b), population exposure?

Parameter-	All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
Category-	—	—	—	—	—	—	—

### II. Probe Siting

	All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
1. Height-	—	—	—	—	—	—	—

2. Obstructions - Distance must be greater than two times the height of the obstruction that extends above the probe. Are there any obstructions? (Yes/No)

a. Obstructed parameter -	All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
	—	—	—	—	—	—	—

b. Distance to Obstruction-	All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
	—	—	—	—	—	—	—

c. Direction of Obstruction -	All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
	—	—	—	—	—	—	—

d. Height above the probe -	All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
	—	—	—	—	—	—	—

### Form 1 Continued

3. Is the probe greater than 20 meters from the dripline of trees? (Yes/No)

If less than 20 meters, how far?	All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
	—	—	—	—	—	—	—

4. Is the Pb/PM<sub>10</sub> sampler greater than two meters from walls, parapets, etc.?  
(Yes/No) If not, how far?

5. Is the continuous monitoring probe greater than one meter from any walls or supporting structure? (Yes/No) If not, how far?

6. Is the SO<sub>2</sub> probe located away from dirty, dusty areas? (Yes/No)

7. 270° Rule - At least 270° (180° if located on the side of a building) around the sampler inlet must be unobstructed. The 270° arc must include the predominant wind direction for the season of expected highest concentration.

8. Is the Pb/PM<sub>10</sub> sampler located in an area that is paved or has vegetative ground cover year round? (Yes/No)

9. Are any furnace or incineration flues nearby? (Yes/No)

If yes, what is the distance between the sampler or probe and the flue?

All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
—	—	—	—	—	—	—

10. For a CO microscale station. Is the probe at least ten meters from an intersection?  
(Yes/No) Distance

11. Distance to nearest traffic lane.

All	PM <sub>10</sub>	SO <sub>2</sub>	CO	O <sub>3</sub>	NO <sub>2</sub>	Pb
—	—	—	—	—	—	—

12. Are all probes, manifolds, candy canes, etc., FEP Teflon or borosilicate glass?  
If not, list parameter and material used.

**COMMENTS:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Form 2 Site Inspection Form

SITE \_\_\_\_\_

AUDITOR \_\_\_\_\_

DATE \_\_\_\_/\_\_\_\_/\_\_\_\_

### CONTINUOUS

DAS, ANALYZERS & RECORDERS CLEAN AND OPERATING PROPERLY YES / NO

DAS, ANALYZERS & RECORDERS READING CONSISTENTLY WITH ONE ANOTHER YES / NO

ZERO/SPAN(S) OPERATING YES / NO

MANIFOLD CLEAN & MOTOR FUNCTIONING YES / NO

CANDY CANE & PROBE LINE(S) CLEAN YES / NO

LOGBOOK(S) DOCUMENTED & CURRENT YES / NO

CALIBRATION FORM(S) ON SITE YES / NO

FIRST AID KIT ON SITE YES / NO

INSTRUMENT MANUAL(S) ON SITE YES / NO

CALIBRATION STICKER(S) CURRENT YES / NO

CYLINDER(S) SECURE YES / NO

INTERIOR: COUNTER, FLOOR, CEILING CLEAN YES / NO

EXTERIOR: GATE, FENCE, STEPS, SKIRTING YES / NO

OBSTRUCTIONS MEET THE 2 TIMES RULE YES / NO

### INTERMITTENT

INSIDE OF SAMPLER(S) CLEAN YES / NO

FILTER HOLDER GASKET IN GOOD CONDITION YES / NO

CALIBRATION STICKER(S) CURRENT YES / NO

ETM(S) FUNCTIONING YES / NO

CLOCK(S) READING CORRECT TIME YES / NO

SAMPLER(S) SECURE: CLIPS, NUTS, CABLES YES / NO

SAFE ACCESS TO SITE: STEPS, RAILING YES / NO

ELECTRICAL CONNECTION(S) TAPED YES / NO

ELEC. CORDS INSULATION & LOCATION GOOD YES / NO

OBSTRUCTIONS MEET THE 2 TIMES RULE YES / NO

### Form 3 Filter Handling Questionnaire

Please answer the following questions. If any questions are answered no, please explain.

**Reporting Agency:** \_\_\_\_\_ **Date:** \_\_\_\_\_

	<u>Yes</u>	<u>No</u>
1. Is the temperature in the weighing facility kept between 15° C to 30° C?	_____	_____
2. Is the temperature in this room controlled within $\pm 3^{\circ}$ C?	_____	_____
3. Is the humidity in the weighing facility kept below 50%?	_____	_____
4. Is the humidity controlled within $\pm 5\%$ ?	_____	_____
5. Is your filter conditioning area free from all acidic or basic gases that might react with the filter media or the collected particulate matter during filter conditioning?	_____	_____
6. Is your analytical balance checked with Class 1 weights prior to weighing filters?	_____	_____
7. Does your company desiccate filters for approximately 24 hours prior to weighing filters before and after runs?	_____	_____
8. Does your company reweigh initial filter weights?	_____	_____
9. Does your company initially inspect filters for irregularities or inconsistencies in the filters?	_____	_____
10. Does your company reweigh exposed filters?	_____	_____
11. Does your company maintain bound filter logbooks?	_____	_____
12. Does your company send all pertinent filter information along with the monitoring report?	_____	_____
13. Does your company transport and store filters separately?	_____	_____
14. Does your company maintain filter information for at least three years?	_____	_____
15. How long after an intermittent sample is collected before the filter is received by the lab?	_____	_____
16. How long after the filter is received by the lab before the analysis is done?	_____	_____